[001] **TITLE OF THE INVENTION:**

[002] Burner Fuel Mixer Head For Concurrently Burning Two Gaseous Fuels

[003] **FIELD OF THE INVENTION**

[004] The present invention relates to a burner fuel mixer head for concurrently burning two gaseous fuels

[005] **BACKGROUND OF THE INVENTION**

[006] Most oil wells produce some low pressure raw gas. Formerly, this low pressure raw gas was vented to atmosphere or diverted to a flare pit. However, stricter environmental regulations have placed limits on venting and flaring, which has lead to the use of this low pressure raw gas as a fuel supply for firetube burners used in various oil processing equipment. Burning raw gas at low pressure (only 1 to 3 pounds per square inch) creates an unacceptable level of emissions. It also heats the firetube unevenly; over heating the close end of the firetube and not providing enough heat to the remote end of the firetube. Therefore, in order to use the low pressure raw gas as a primary fuel supply, the pressure is usually increased by mixing the low pressure raw gas with a reliable source of pressurized feed gas. The combustion efficiency of the burner depends upon how well the low pressure raw gas can be fed to the burner along with the pressurized feed gas.

[007] **SUMMARY OF THE INVENTION**

[008] What is required is a burner fuel mixer head that effectively feeds low pressure raw gas to the burner with pressurized feed gas.

[009] According to the present invention there is provided a burner fuel mixer head which includes a primary housing and a secondary housing. The primary housing has an interior cavity defining a fuel/air mixing chamber. The primary housing also has a mixed fuel gas inlet, a combustion air

inlet, and a mixed fuel/air outlet all of which communicate with the interior cavity. The secondary housing has an interior cavity defining a fuel mixing chamber. The interior cavity of the secondary housings communicates with the mixed fuel gas inlet leading into the primary housing. The secondary housing has a pressurized fuel gas inlet and a low pressure fuel gas inlet.

[010] A venturi throat with converging sidewalls is positioned in the mixed fuel gas inlet. A venturi nozzle communicates with the pressurized fuel gas inlet with a first end of the venturi nozzle extending into the fuel mixing chamber in axial alignment with the venturi throat. This forms a venturi, such that a pressurized flow of pressurized fuel gas through the venturi draws low pressure fuel gas from the fuel mixing chamber of the secondary housing through the mixed fuel gas inlet into the fuel/air mixing chamber of the primary housing.

[011] With the burner fuel mixer head, as described above, pressurized fuel gas passing through the venturi draws low pressure fuel gas from the fuel mixing chamber of the secondary housing into the fuel/air mixing chamber of the primary housing.

[012] Although beneficial results may be obtained through the use of the burner fuel mixer head, as described above, the quantity of low pressure gas produced varies from well to well. It is, therefore, desirable that some means be provided for adjusting the proportions of pressurized fuel gas and low pressure fuel gas. Even more beneficial results may, therefore, be obtained when the venturi nozzle is positioned in a pressurized fuel gas inlet passage and the venturi nozzle is axially movable in the pressurized fuel gas inlet passage, such that the venturi nozzle can be moved either toward or away from the venturi throat to adjust the relative proportions of pressurized fuel gas and low pressure fuel gas being fed through the mixed fuel gas inlet into the

fuel/air mixing chamber.

[013] There are various ways of making the venturi nozzle axially adjustable in the pressurized fuel gas inlet passage. Beneficial results have been obtained when the pressurized fuel gas inlet passage has an interior sidewall with threads and a second end of the venturi nozzle has an exterior surface with threads. This enables the venturi nozzle to be maintained in threaded engagement with the interior sidewall of the pressurized fuel gas inlet passage. Rotation of the venturi nozzle results in axial movement of the venturi nozzle in the pressurized fuel gas inlet passage. In order to facilitate such adjustment it is preferred that the second end of the venturi nozzle has a tool receiving receptacle. This enables the venturi nozzle is rotated by means of a tool extended into the pressurized fuel gas inlet passage and engaged with the tool receiving receptacle.

[014] In order to avoid unintended movement of the venturi nozzle, it is preferred that an externally threaded lock nut be provided which engages the threads in the pressurized fuel gas inlet passage to maintain the axial positioning of the venturi nozzle.

[015] It is also preferred that a venturi effect be created in the fuel/air mixing chamber so that it draws combustion air effectively. This is accomplished by providing the mixed fuel/air outlet of the primary housing with converging sidewalls.

[016] **BRIEF DESCRIPTION OF THE DRAWINGS**

[017] These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to in any way limit the scope of the invention to the particular embodiment or embodiments shown, wherein:

[018] **FIGURE 1** is a side elevation view, in section, of a burner fuel mixer head constructed in accordance with the teachings of the present invention.

[019] **FIGURE 2** is a side elevation view, in section, of a second embodiment of a burner fuel mixer head constructed in accordance with the teachings of the present invention.

[020] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[021] The preferred embodiment, a burner fuel mixer head generally identified by reference numeral 10, will now be described with reference to **FIGURE 1**.

[022] Structure and Relationship of Parts:

[023] Referring to **FIGURE 1**, there is provided a burner fuel mixer head 10 which includes a primary housing 12 and a secondary housing 14. Primary housing 12 has an interior cavity 16 that defines a fuel/air mixing chamber 18. Primary housing 12 has a mixed fuel gas inlet 20, a combustion air inlet 22, and a mixed fuel/air outlet 24 all of which communicate with interior cavity 16. Mixed fuel/air outlet 24 of primary housing 12 has converging sidewalls 26.

[024] Secondary housing 14 has an interior cavity 28 that also defines a fuel mixing chamber 30. Interior cavity 28 of secondary housing 14 communicates with mixed fuel gas inlet 20 leading into primary housing 12. Secondary housing 14 has a pressurized fuel gas inlet 32 and a low pressure fuel gas inlet 34.

[025] A venturi throat 36 with converging sidewalls 38 is positioned in mixed fuel gas inlet 20. A pressurized fuel gas inlet passage 40 leads from pressurized fuel gas inlet 32 to fuel mixing chamber 30 of secondary housing 14. A venturi nozzle 42 is positioned in pressurized fuel gas inlet passage 40 and communicates with pressurized fuel gas inlet 32. A first end 44 of venturi nozzle 42 extends into fuel mixing chamber 30 in axial alignment with venturi throat 36 to form a venturi generally referenced by numeral

46, such that a pressurized flow of pressurized fuel gas through venturi 46 draws low pressure fuel gas from fuel mixing chamber 30 of secondary housing 14 through mixed fuel gas inlet 20 into fuel/air mixing chamber 18 of primary housing 12.

[026] Pressurized fuel gas inlet passage 40 has an interior sidewall 52 with threads 54 and a second end 48 of venturi nozzle 42 has an exterior surface 56 with threads 58, such that venturi nozzle 42 is maintained in threaded engagement with interior sidewall 52 of pressurized fuel gas inlet passage 40. Second end 48 of venturi nozzle 42 has a tool receiving receptacle 50, whereby venturi nozzle 42 is rotated by means of a tool (not shown) that is extended into pressurized fuel gas inlet passage 40 and engaged with tool receiving receptacle 50. Rotation of venturi nozzle 42 results in axial movement of venturi nozzle 42 in pressurized fuel gas inlet passage 40. Axially movement of venturi nozzle 42 in pressurized fuel gas inlet passage 40 moves venturi nozzle 42 either toward or away from venturi throat 36 to adjust the relative proportions of pressurized fuel gas and low pressure fuel gas being fed through mixed fuel gas inlet 20 into fuel/air mixing chamber 18. An externally threaded lock nut 60 is provided to maintain the axial positioning of venturi nozzle 42 in pressurized gas inlet passage 40. Lock nut 60 also has a tool receiving receptacle 50.

[027] Combustion air inlet 22 of primary housing 12 has a cover plate 62. A portion of secondary housing 14 through which pressurized gas inlet passage 40 extends has external threads 64. Cover plate 62 is threadedly engaged with external threads 64 for movement either toward or away from combustion air inlet 22, so that the amount of combustion air fed into fuel/air mixing chamber 18 can be controlled. A screw 66 extends through an aperture 68 in cover plate 62 and engages secondary housing 14 to serve as a rotational

stop which maintains cover plate 62 in a selected rotational position. A coupling 70 and associated gasket 72 are used to couple conduit (not shown) leading from a source of pressurized gas to pressurized gas inlet passage 40.

[028] It will be appreciated that venture nozzles 42 are manufactured and installed at differing lengths depending on the on-site specifications. Venturi nozzles 42 of secondary can be either an adjustable venturi nozzle or a drop in venturi nozzle, however both types of venturi nozzles 42 still require lock nut 60 to maintain the axial positioning of venturi nozzle 42 in pressurized gas inlet passage 40.

[029] Operation:

[030] The use and operation of burner fuel mixer head 10 will now be described with reference to **FIGURE 1**. Referring to **FIGURE 1**, burner fuel mixer head 10 is used to effectively feed low pressure gas raw gas and a pressurized gas feed.

[031] High volume low pressure (1 oz-6 psi) gas that is supplied through pressurized fuel gas inlet 32 is fed along pressurized fuel gas passage 40 through venturi nozzle 42 creating a vacuum effect in fuel mixing chamber 30, and then is passed through venturi throat 36 with converging sidewalls 38 thus drawing preheated flue gas in through low pressure fuel inlet 34.

[032] In the event that preheating of flue gas is not required, low pressure waste gas can be supplied through low pressure fuel inlet 34. High volume low pressure gas of sufficient supply pressure (1 oz - 6 psi) and volume through fuel gas inlet 32 is fed through venturi nozzle 42 creating a vacuum in fuel mixing chamber 30 and is then passed through venturi throat 36 with converging sidewalls 38 drawing low pressure waste gas in through low pressure fuel inlet 34.

[033] Adjustments may be made by inserting a tool into tool receptacle 50 on venturi nozzle 42. Through use of such a tool, venturi nozzle 42 can be rotated to move axially within pressurized fuel gas inlet passage 40 toward or away from venturi throat 36. This permits adjustment of the relative proportions of pressurized fuel gas and low pressure fuel gas being fed through mixed fuel gas inlet 20 into fuel/air mixing chamber 18. Adjustments may be made to the supply of combustion air by temporarily removing screw 66 which serves as a rotational stop for cover plate 62, and then rotating cover plate 62 toward or away from combustion air inlet 22.

[034] The advantages of burner fuel mixer head 10, as described above are as follows;

[035] - it provides a high volume fuel gas for combustion at low pressure.

[036] - it facilitates a high velocity flue gas flow even at low fuel pressure.

[037] - it provides dual fuel capability (propane / solution gas / well head gas / line gas) without burner readjustment.

[038] - it enables lower emissions and increased of combustion efficiency while reducing the risk of firetube hot spots and flame impingement.

[039] - it increases flue gas velocity with out increasing stack discharge temperature.

[040] - it provides increased flue gas velocity to enhance thermal efficiency and to reduce firetube hot spots and flame impingement.

[041] - it eliminates mixer head freeze up in temperatures below 0 degrees Celcius.

[042] - it provides the ability to combust low pressure gases that normally get vented into our atmosphere or burnt off in an inefficient flare stack. These gases are not normally high enough in volume to make it economical to compress them but they still make up a sizeable

portion of the environmental pollution today. Now they can be a valuable fuel source with out any further expenditures. This is possible because of the intense vacuum created by this mixer head configuration.

[043] A second embodiment of burner fuel mixer head generally identified by reference numeral 100, will now be described with reference to **FIGURE** 2. The components of the second embodiment 100 will be identified by the same reference numerals as used in the description above, so that only the differences need to be identified and specifically described.

[044] Structure and Relationship of Parts:

[045] Referring to **FIGURE** 2, there is provided a second embodiment of burner fuel mixer head 100 which is adapted to be used where the supply of gas is freezing. Second embodiment 100 is substantially the same as first embodiment 10 except that with second embodiment 100 instead of coupling 70 and associated gasket 72 being used to couple conduit (not shown) leading from a source of pressurized gas to pressurized gas inlet passage 40, a third housing 110 with an interior cavity 112 is threadably coupled with secondary housing 14. Interior cavity 112 defines a fuel mixing chamber 114. Third housing 110 has a pressurized fuel gas inlet 116 and a low pressure fuel gas inlet 118. A venturi nozzle 120 is positioned between pressurized fuel gas inlet 116 and mixing chamber 114 in a pressurized fuel gas inlet passage 122. Pressurized fuel gas inlet passage 122 has an interior sidewall 124 with threads 126 and flow nozzle 120 has an exterior surface 128 with threads 130, such that venturi nozzle 120 is maintained in threaded engagement with interior sidewall 124 of pressurized fuel gas inlet passage 122. Rotation of venturi nozzle 120 results in axial movement of venturi nozzle 120 in pressurized fuel gas inlet passage 122 to move venturi nozzle 120 either toward or away from second end 48 of

venturi nozzle 42 in secondary housing 14 so as to adjust the relative proportions of pressurized fuel gas and low pressure fuel gas being fed through to mixing chamber 30 in secondary housing 14.

[046] Interior cavity 116 of third housing 110 communicates with mixing chamber 30 of second housing 14 via venturi nozzle 42. Pressurized fuel gas inlet 32 is adapted to couple with conduit (not shown) leading from a source of pressurized gas.

[047] Operation:

[048] With second embodiment 100, if high volume low pressure gas entering through pressurized fuel gas inlet 116 is freezing in mixing chamber 114, then supply of low pressure preheated fuel gas can be moved from low pressure fuel inlet 34 in secondary housing 14 to low pressure fuel inlet 118 in third housing 110 without jeopardizing the functioning of burner fuel mixer head 100. In this situation, high volume low pressure gas of sufficient supply pressure (1 oz - 6 psi) and volume is supplied through pressurized fuel gas inlet 116. High volume low pressure gas is fed through flow nozzle 120 creating a vacuum in fuel mixing chamber 114. Fuel mixture of high pressure low volume fuel gas and waste gas is then passed through mixed fuel gas inlet 20 to create a vacuum in fuel mixing chamber 30 of secondary housing 14.

[049] In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one of the elements.

[050] It will be apparent to one skilled in the art that modifications may be made to the illustrated embodiment

without departing from the spirit and scope of the invention as hereinafter defined in the Claims.